You are advised to spend the first TEN minutes of the examination time:
   a. reading the instructions.
   b. becoming familiar with the questions.

INSTRUCTIONS
1. This paper consists of THREE sections.
   SECTION A       Multiple Choice          15 Marks
   SECTION B       Long Answers            33 Marks
   SECTION C       Options                  72 Marks

2. Write your Student Personal Identification Number (SPIN) on the top right hand corner of this page and on page 31.
3. SECTION A and SECTION B are COMPULSORY.
4. SECTION C consists of FIVE options. You are required to answer only FOUR of the FIVE options.
5. Answer ALL questions in the space provided in this booklet.
6. Check that your paper consists of 31 pages.

YOU MUST HAND THIS BOOKLET TO THE SUPERVISOR AT THE END OF THE EXAMINATION.

TOTAL MARKS

120
SECTION A: MULTIPLE CHOICE          (15 marks)

Place a tick in the box corresponding to the correct answer.

For example:

\[
\begin{array}{cccc}
A & B & C & D \\
\sqrt{} & & \\
\end{array}
\]

If you want to change your answer to D, cross out A and tick the box under D.

\[
\begin{array}{cccc}
A & B & C & D \\
\times & & \sqrt{} \\
\end{array}
\]

1. Which of the following \textbf{safety} gears must be worn when removing metal with a chisel and a hammer?  
   \begin{itemize}
   \item A. Overall
   \item B. Glasses
   \item C. Earmuffs
   \item D. Helmet
   \end{itemize}

2. Accidents in school workshops can be prevented by:
   \begin{itemize}
   \item A. storing portable tools in a separate room.
   \item B. following your classmates instructions.
   \item C. completing the project on time.
   \item D. getting teacher's permission before using machine.
   \end{itemize}

3. The correct saw used to cut curves in thin timber is:
   \begin{itemize}
   \item A. Combination saw.
   \item B. Tenon saw.
   \item C. Coping saw
   \item D. Rip saw.
   \end{itemize}

4. Brass is an alloy of:
   \begin{itemize}
   \item A. Copper and Zinc.
   \item B. Copper and Tin.
   \item C. Copper and Lead.
   \item D. Copper and Aluminium.
   \end{itemize}
5. Particle board is also known as:
   A. masonate.
   B. plywood.
   C. chip-board.
   D. block-board.

6. The gap between the grinding wheel and the tool rest of a bench grinding machine should NOT be more than:
   A. 6 millimeters.
   B. 5 millimeters.
   C. 4 millimeters.
   D. 2 millimeters.

7. Air Gap in a water tap allows:
   A. user convenience.
   B. air pressure.
   C. water pressure.
   D. water to run faster.

8. The best water tap to use in public places is:
   A. Spring tap.
   B. Plug tap.
   C. Screw down tap.
   D. Plastic plug tap.

9. What voltage does a single-phase electrical circuit supply here in Tonga?
   A. 110 volts
   B. 240 volts
   C. 350 volts
   D. 415 volts

10. Which electronic component limits the current to values used by various components?
    A. Power diode.
    B. Transformer.
    C. Transistor.
    D. Resistor.
11. If the plan of a building is drawn to a scale of 1:50, what is the length of the building if its scaled length is 150 mm?
   A. 75 mm  
   B. 750 mm  
   C. 7,500 mm  
   D. 75,000 mm

12. The drawing which gives the details of doors and windows of a building is:
   A. End elevation.  
   B. Sectional elevation.  
   C. Front elevation.  
   D. Floor elevation.

**Question 13 and 14 require you to select the CORRECT statement.**

13. **Valves:** The inlet valve of the four stroke engine:
   A. opens to allow fuel into the cylinder.  
   B. opens once in every revolution of the engine.  
   C. closes just as the exhaust valve opens.  
   D. closes during the induction or suction stroke.

14. **Fuels:**
   A. In a four stroke motor, a mixture of petrol and oil is used.  
   B. In a two stroke motor, petrol is used on its own.  
   C. The fuel passes through the distributor before entering the motor.  
   D. The air cleaner or filter prevents dust from getting into the fuel system.

15. How many views are commonly drawn in Orthographic Projection drawing?
   A. Four Views.  
   B. Three Views.  
   C. Two Views.  
   D. One View.
SECTION B: LONG ANSWER (33 marks)

YOU ARE REQUIRED TO ANSWER ALL THE QUESTIONS IN THIS SECTION.

QUESTION ONE: SMALL ENGINE (7 marks)

1. **The Four Stroke Cycle Engine.** (4 marks)

   Use ONLY the words listed in the table below to complete the statement for the Four Stroke Cycle.

   - **Four Stroke Cycle:**
     In the four strokes cycle there is one power for every ______________ revolution of the crankshaft.

   - **Induction Stroke:**
     As the piston moves down the cylinder the ____________ valve opens. This action sucks the fuel/air mixture from the _____________ into the cylinder.

   - **________________ Stroke:**
     Both valves are closed as the piston travels upwards and the fuel/air mixture is squeezed in to the small space at the top of the cylinder.

   - **Power Stroke:**
     When the piston arrives at ____________center, a spark at the _____________ ignites the hot fuel/air mixture. This is ________________ combustion and it forces the piston down.

   - **Exhaust Stroke:**
     The exhaust valve opens as the piston comes up and the waste ____________ are pushed out.
2. **Lubrication:** (3 marks)

   a. Briefly explain how the application of thin oil reduces the friction between surfaces

   ____________________________________________________________________________

   ____________________________________________________________________________

   (1 mark)

   b. Briefly explain how engine oil takes away the heat in a four stroke engine.

   ____________________________________________________________________________

   ____________________________________________________________________________

   (1 mark)

   c. Give ONE (1) other use that the engine oil has other than reducing friction or taking away heat between moving parts.

   ____________________________________________________________________________

   ____________________________________________________________________________

   (1 mark)
QUESTION TWO: BASIC ELECTRICITY (7 marks)

1. The data plate on a washing machine shows the following details:

<table>
<thead>
<tr>
<th>AQUARIUS 824 Washing Machine</th>
</tr>
</thead>
<tbody>
<tr>
<td>240 V 1 Ph</td>
</tr>
<tr>
<td>AC 50HZ 5 A</td>
</tr>
</tbody>
</table>

Use the following information together with the details on the data plate above to answer the following questions.

**Washing machine working hours per day** = 5 hours
**Number of days per month** = 30 working days
**Tonga Power Limited charge** = 86 cents per unit (per kWh)

a. Calculate the Power rating of the washing machine.

b. Calculate the number of the washing machine working hours per months.
c. Calculate the Kilowatt hour per month of the washing machine.

(1 mark)

d. Calculate the cost of the washing machine being used for 1 month or 30 days.

(1 mark)

2. Study the floor plan of a storage shed given below and answer the following questions.

![Floor Plan of a Storage Shed]

Complete the table below with the correct name of electrical fittings a, b, c and d.

<table>
<thead>
<tr>
<th>Symbols</th>
<th>Correct name of electrical Fittings</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td></td>
</tr>
<tr>
<td>b</td>
<td></td>
</tr>
<tr>
<td>c</td>
<td></td>
</tr>
<tr>
<td>d</td>
<td></td>
</tr>
</tbody>
</table>

(2 marks)
1. The **Diagram 1** below shows common fittings to be used with service pipes for water distribution which identified by the project plan on **Diagram 2** on the next page.

**Diagram 1:** Common fittings for plumbing services.
The project requires the connection of an Ø20 mm service pipe to the main. This is to be reduced to Ø12 mm pipes, valves and taps to service the property shown below.

**Diagram 2: Project plan.**

Complete the table below by filling in the types and its sizes and the quantity of fittings needed for the joints indicated by the numbers.

<table>
<thead>
<tr>
<th>Connections</th>
<th>Type of fittings and sizes</th>
<th>Quantity Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
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<tr>
<td>3</td>
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<td>4</td>
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<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
1. Study the diagram below and answer the following questions.

   a. On the diagram below, name each member in the spaces provided.

   b. Complete the drawing above to show the following members correctly in position.

   i. Batten
   ii. Bottom Plate
   iii. Fascia Board
   iv. Floor
2. Describe briefly the process of setting out profile or hurdles.

<table>
<thead>
<tr>
<th>Processes</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Erect Profile</td>
<td></td>
</tr>
<tr>
<td>b. Datum height</td>
<td></td>
</tr>
<tr>
<td>c. 3,4,5 method</td>
<td></td>
</tr>
</tbody>
</table>

(3 marks)
1. Write down the name of the project that you design and make this year. List THREE (3) things that should have been done to improve the outcome of your project.

Project:
____________________________________________________________________________

a. _________________________________________________________________________
   _________________________________________________________________________

b. _________________________________________________________________________
   _________________________________________________________________________

c. _________________________________________________________________________
   _________________________________________________________________________

(3 marks)

2. Briefly describe the project assessment elements listed below.

Dimensioning
____________________________________________________________________________
____________________________________________________________________________

a. Quality:
____________________________________________________________________________
____________________________________________________________________________

b. General Appearance:
____________________________________________________________________________
____________________________________________________________________________

(3 marks)
SECTION C: OPTIONS (72 marks)

INSTRUCTION: You are required to attempt only FOUR (4) of the FIVE options.

Each option worth 18 Marks.

OPTION ONE: HOME APPLIANCES

OPTION TWO: TECHNICAL DRAWING

OPTION THREE: LAND SURVEYING

OPTION FOUR: NAVIGATION

OPTION FIVE: ELECTRONICS
1. Study the Wick Stove given below then answer question a and b.

**Wick Stove**

a. List THREE (3) important points on how to maintain a Wick Stove.
   
   i. 
   
   ii. 
   
   iii. 

   (3 marks)

b. Name the FOUR (4) main parts of the Wick Stove.

   i. 
   
   ii. 
   
   iii. 
   
   iv. 

   (2 marks)
2. Study the diagram below of the Kerosene Pressure Stove and answer the following questions.

**Kerosene Pressure Stove**

For better service and long life of the Kerosene Pressure Stove the following steps should be followed while operating it.

Complete the following steps on how **to light** and to **turn off** the Kerosene Pressure Stove.

a. **To Light**
   i. Fill the warm-up pan with spirit.
   ii. Light it
   iii. When Spirit is about to finish, close vent screw.
   iv. ____________________________
   v. ____________________________
   vi. ____________________________
   vii. ____________________________

b. **To turn off the Stove**
   i. ____________________________

(5 marks)
3. Under the sub-headings below, List the causes and the remedies to the problems of a Kerosene Pressure Stove.

<table>
<thead>
<tr>
<th>Problems</th>
<th>Causes</th>
<th>Remedies</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Improper pressure in tank</td>
<td>i.</td>
<td>i.</td>
</tr>
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<td></td>
<td>ii.</td>
<td>ii.</td>
</tr>
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<td></td>
<td>iii.</td>
<td>iii.</td>
</tr>
<tr>
<td></td>
<td>iv.</td>
<td>iv.</td>
</tr>
<tr>
<td>b. Improper flame</td>
<td>i.</td>
<td>i.</td>
</tr>
<tr>
<td></td>
<td>ii.</td>
<td>ii.</td>
</tr>
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<td></td>
<td>iii.</td>
<td>iii.</td>
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<tr>
<td></td>
<td>iv.</td>
<td>iv.</td>
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</tbody>
</table>

(8 marks)
1. Construct a circle to neatly touch the three sides of the triangle below.

2. Construct a regular pentagon with line \( AB \) as its base.
3. **ORTHOGRAPHIC PROJECTION** (12 marks)

A pictorial view of a bracket is given below. Draw the following views in first angle projection with 1:1 scale.

i. Front view from A

ii. Top view
1. Plot the piece of land enclosed by the Traverse method provided in the table below.

Determine the missing details – bearing and distance.

**Scale:** 1mm: 2m

**Bearing are given in degrees and distance in meters.**

<table>
<thead>
<tr>
<th>STATION</th>
<th>DISTANCE</th>
<th>FORWARD BEARING</th>
<th>BACKWARD BEARING</th>
</tr>
</thead>
<tbody>
<tr>
<td>A – B</td>
<td>88.0</td>
<td>78°</td>
<td></td>
</tr>
<tr>
<td>B – C</td>
<td>75.0</td>
<td>107°</td>
<td></td>
</tr>
<tr>
<td>C – D</td>
<td>93.0</td>
<td>185°</td>
<td></td>
</tr>
<tr>
<td>D – E</td>
<td>102.0</td>
<td>262°</td>
<td></td>
</tr>
<tr>
<td>E – A</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Scale: 1mm: 2m

**Diagram:**

- North Arrow
- Land boundaries

(8 marks)
2. A block of land, ABCDEF, is shown to a scale of 1:1000.

![Diagram of ABCDEF]

a. Complete the field book for a chain survey of the area using offsets from a straight line taken between pegs A and D.

**Field Book**

<table>
<thead>
<tr>
<th>LEG</th>
<th>DISTANCE</th>
<th>F/BEARING</th>
<th>B/BEARING</th>
</tr>
</thead>
<tbody>
<tr>
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</tbody>
</table>

(4 marks)

b. Complete the field book of the same block using the compass traverse method.

**Field Book**

<table>
<thead>
<tr>
<th>LEG</th>
<th>DISTANCE</th>
<th>F/BEARING</th>
<th>B/BEARING</th>
</tr>
</thead>
<tbody>
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</tbody>
</table>

(6 marks)
1. Briefly explain the following sea terms:
   i. Knots: ____________________________________________________________
   ii. Starboard: ______________________________________________________
   iii. Leg: ____________________________________________________________
   iv. Beacons: _________________________________________________________

2. I am departing from ‘Eua at 0745 hrs tomorrow on a trip to a nearby island which is 21 nautical miles away. The boat travels at 8.4 knots.
   i. Calculate the ETA (expected time arrival) at the island.

3. On the Tongatapu Group chart the magnetic variation is 13° 18´ E in 1996. The annual drift is 04´ E. What is the magnetic variation for the year 2014?
4. Complete the table below

<table>
<thead>
<tr>
<th>COMPASS BEARING</th>
<th>MAGNETIC BEARING</th>
<th>TRUE BEARING</th>
</tr>
</thead>
<tbody>
<tr>
<td>_______________</td>
<td>11°34' W</td>
<td>105°</td>
</tr>
<tr>
<td>309°10'</td>
<td>_______________</td>
<td>322°</td>
</tr>
<tr>
<td>138°12'</td>
<td>13°31' W</td>
<td>_______________</td>
</tr>
</tbody>
</table>

(3 marks)

5. MV Pulupaki is near Hunga Island and wanted to locate her position. The captain collected the following information:

- MV Pulupaki course is 76°.
- At 0812 hrs Hunga light point bears 309°.
- At 1012 hrs Hunga light point bears 268°.
- MV Pulupaki average speed is 7.5 knots.

Determine the position of the MV Pulupaki using running fix method. Use scale of 5 mm = 1nm.

_HUNGA LIGHT POINT_ ☆

(6 marks)
OPTION FIVE: ELECTRONICS (18 marks)

1. The diagram below represents the circuit of an electronic device. The symbol of each component is shown.

![Circuit Diagram]

Complete the table below by writing the correct full name of the component symbols indicated by numbers in the space provided.

<table>
<thead>
<tr>
<th>Component Number</th>
<th>Name of the Component</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td></td>
</tr>
</tbody>
</table>

(3 marks)
2. The table below has given pictures of electronics components. Write the name and function for each component.

<table>
<thead>
<tr>
<th>PICTURE</th>
<th>NAME</th>
<th>FUNCTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>![Component Image 1]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>![Component Image 2]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>![Component Image 3]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>![Component Image 4]</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(6 marks)

3. Manufacturers of Light Emitting Diode (LED) provide you with two possible ways to easily identify the negative terminal of a LED. Describe each way.

i. 

ii. 

(2 marks)

4. **CAPACITOR**

i. Calculate the value of the given capacitor. Give your answer in micro Farads (μF)

(2 marks)
ii. What does 25 stand for?

(1 mark)

5. Use the information below to work out the value of the TWO (2) resistors.

Value of Resistor 1:

Value of Resistor 2 Blue:

(2 marks)
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TONGA SCHOOL CERTIFICATE

2014

INDUSTRIAL ARTS

(For markers Use only)

<table>
<thead>
<tr>
<th>SECTION</th>
<th>MARK</th>
<th>CHECK MARK</th>
<th>TOTAL MARK</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td></td>
<td></td>
<td>15</td>
</tr>
<tr>
<td>B</td>
<td></td>
<td></td>
<td>33</td>
</tr>
<tr>
<td>C</td>
<td></td>
<td></td>
<td>72</td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td></td>
<td>100</td>
</tr>
</tbody>
</table>